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FORM PTO-1390 (REV. 11-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
32860-000265/US	NEW 10/031125

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/02071	June 26, 2000	July 9, 1999

TITLE OF INVENTION

ELECTRICAL BONDING PROTECTED AGAINST OXIDATION ON THE GAS COMBUSTION SIDE OF A HIGH-TEMPERATURE FUEL CELL

APPLICANT(S) FOR DO/EO/US

Thomas JANSING

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau). WO 00/
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is transmitted herewith.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4)
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 20. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98-1449 and International Search Report (PCT/ISA/210) in German.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☒ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information:
    1) One (1) sheets of Formal Drawings

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U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/031125	PCT/DE00/02071	32860-000265/US

21. ☒ The following fees are submitted:

		CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.	**$1,040.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$890.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.	**$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$690.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4).	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$ 890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$ 130.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	20 - 20 =	0	X **$18.00**	$ 0	
Independent Claims	2 - 3 =	0	X **$80.00**	$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)		None	+ **$270.00**	$ 0	
TOTAL OF ABOVE CALCULATIONS =				$ 1,020.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$ 0	
SUBTOTAL =				$ 1,020.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$ 0	
TOTAL NATIONAL FEE =				$ 1,020.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 1,020.00	
				Amount to be: refunded	$
				charged	$

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account. No. 08-0750 in the amount of $1,020.00 to cover the above fees. A triplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-0750.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:
Harness, Dickey & Pierce, P.L.C – Customer No. 30596
Post Office Box 8910
Reston, Virginia 20195

Date: January 9, 2002

By [signature]
Donald J. Daley, #34,313

kna

10/031125
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PATENT
32860-000265/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicants: Thomas JANSING

Int'l Application: PCT/DE00/02071

Application No.: **NEW**

Filed: January 9, 2002

For: ELECTRICAL BONDING PROTECTED AGAINST OXIDATION ON THE GAS COMBUSTION SIDE OF A HIGH-TEMPERATURE FUEL CELL

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

January 9, 2002

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

IN THE ABSTRACT

Please replace the Abstract with the attached revised Abstract.

IN THE CLAIMS

Please replace the original claims with the following new claims:

1. A fuel cell, comprising:

a cathode;

an electrolyte;

an anode;

interconnector plates; and

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at least one metallic mesh, inserted between the anode and an interconnector plate for flexibly making contact, wherein the at least one metallic mesh is protected against oxidation.

2. The fuel cell as claimed in claim 1, wherein the at least one metallic mesh is coated with an oxidation-resistant protective layer.

3. The fuel cell as claimed in claim 1, wherein the mesh is a coated nickel mesh.

4. The fuel cell as claimed in claim 1, wherein the mesh is a coated stainless steel mesh.

5. The fuel cell as claimed in claim 2, wherein the protective layer includes chromium.

6. The fuel cell as claimed in claim 2, wherein the protective layer includes chromium carbide.

7. The fuel cell as claimed in claim 6, wherein at least one of Cr_3C_2, CrC, Cr_7C_3 and $Cr_{23}C_6$ is used as chromium carbide.

8. The fuel cell as claimed in claim 1, wherein the protective layer has a thickness of approximately 0.1-10 μm.

Please add the following new claims:

-- 9. The fuel cell as claimed in claim 2, wherein the mesh is a coated nickel mesh.

10. The fuel cell as claimed in claim 2, wherein the mesh is a coated stainless steel mesh.

11. The fuel cell as claimed in claim 3, wherein the protective layer includes chromium.

12. The fuel cell as claimed in claim 4, wherein the protective layer includes chromium.

13. The fuel cell as claimed in claim 3, wherein the protective layer includes chromium carbide.

14. The fuel cell as claimed in claim 4, wherein the protective layer includes chromium carbide.

15. The fuel cell as claimed in claim 5, wherein the protective layer includes chromium carbide.

16. A fuel cell stack, comprising:

a plurality of fuel cells, each fuel cell including,

a cathode,

an electrolyte,

an anode,

interconnector plates, and

at least one metallic mesh, inserted between the anode and an interconnector plate for flexibly making contact, wherein the at least one metallic mesh is protected against oxidation.

17. The fuel cell stack of claim 16, wherein the at least one metallic mesh is coated with an oxidation-resistant protective layer.

18. The fuel cell stack of claim 16, wherein the mesh is a coated nickel mesh.

19. The fuel cell stack of claim 17, wherein the mesh is a coated nickel mesh.

20. The fuel cell stack of claim 16, wherein the mesh is a coated stainless steel mesh.

REMARKS

Claims 1-20 are now present in this application, with new claims 9-20 being added by the present Preliminary Amendment. It should be noted that the amendments to original claims 1-8 of the present application are non-narrowing amendments, made solely to place the claims in proper form for U.S. practice and not to overcome any prior art or for any other statutory considerations. For example, amendments have been made to broaden the claims; remove reference numerals in the claims; remove the European phrase "characterized in that"; remove multiple dependencies in the claims; and to place claims in a more recognizable U.S. form, including the use of the transitional phrase "comprising" as well as the phrase "wherein". Other such non-narrowing amendments include rearranging apparatus-type claims (setting elements forth in separate paragraphs) into a more recognizable U.S. form. Again, all amendments are non-narrowing and have been made solely to place the claims in proper form for U.S. practice and not to overcome any prior art or for any other statutory considerations.

SUBSTITUTE SPECIFICATION

In accordance with 37 C.F.R. §1.125, a substitute specification has been included in lieu of substitute paragraphs in connection with the present Preliminary Amendment. The substitute specification is submitted in clean form, attached hereto, and is accompanied by a marked-up version showing the changes made to the original specification. The changes have been made in an effort to place the specification in better form for U.S. practice. No new matter has been added by these changes to the specification. Further, the substitute specification includes paragraph numbers to facilitate amendment practice as requested by the U.S. Patent and Trademark Office.

CONCLUSION

Accordingly, in view of the above amendments and remarks, an early indication of the allowability of each of claims 1-20 in connection with the present application is earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Donald J. Daley at the telephone number of the undersigned below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY & PIERCE, P.L.C

By: ______________________
Donald J. Daley, Reg. No. 34,313

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DJD:kna

ABSTRACT OF THE DISCLOSURE

A fuel cell or a fuel cell stack includes cathodes arranged in parallel in layers, an electrolyte, anodes and interconnector plates. Further, at least one metallic mesh is included, which is inserted between an anode and an interconnector plate for flexibly making contact. The at least one metallic mesh is protected against oxidation.

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New PCT Application
Docket No. 32860-000265/US

SUBSTITUTE SPECIFICATION

ELECTRICAL BONDING PROTECTED AGAINST OXIDATION ON THE GAS COMBUSTION SIDE OF A HIGH-TEMPERATURE FUEL CELL

[0001] This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/DE00/02071 which has an International filing date of June 26, 2000, which designated the United States of America, the entire contents of which are hereby incorporated by reference.

Field of the Invention

[0002] The invention generally relates to a fuel cell or a fuel cell stack.

Background of the Invention

[0003] It is known that connecting a plurality of fuel cells in series results in a fuel cell stack. Such a fuel cell stack includes an interconnector plate, a protective layer, a contact layer, a cathode, an electrolyte, an anode, a further contact layer and a further interconnector plate. The interconnector plate forms a unit with the protective and contact layers, which are each sprayed on. Cathode, electrolyte and anode form the electrolyte/electrodes unit. The corresponding units are laid in parallel, in layers, on top of one another and the same sequence is repeated a number of times.

[0004] Cathode, electrolyte and anode form an electrolyte/electrodes unit. In each case one electrolyte/electrodes unit, lying between adjacent interconnector plates, together with the contact and protective layers which bear directly against the electrolyte/electrodes unit on both sides, forms a high-temperature fuel cell. The fuel cell also includes those sides of each of the two interconnector plates which bear against the protective layer or the contact layers. The interconnector plates usually consist of CrFe5 with 1% of Y oxide, known as an ODS alloy.

[0005] Gas ducts, through which, firstly, the fuel gas, for example hydrogen or methane (natural gas), and, secondly, oxygen or air is passed, are formed in the interconnector plate. The hydrogen is passed to the anode side, the oxygen or air to the cathode side. These gases are passed through at a relatively low excess pressure of less than 1 bar.

[0006] The planar design of the high-temperature fuel cell requires the contact between the electrodes in both gas spaces to be over as much of the surface as possible. On the cathode side, contact with the electrode is ensured by a contact layer made from La perovskite, e.g. $La_8SrO_{0.2}MnO_3$. This perovskite is stable in air. By contrast, on the fuel cell side contact with the electrode, i.e. the anode, is more difficult to achieve. However, complete contact with the

anode is necessary, on account of the low transverse conductivity of the anode. The anode is produced by the screen-printing process and is therefore not planar over the entire surface, which means that a flexible contact-making element which has very good electrical conductivity and must be able to withstand an operating period of approximately 40,000 h is required.

[0007] The prior art provides for nickel meshes to be used as flexible contact-making elements. By way of example, a fine nickel mesh and a coarse nickel mesh are laid on top of one another and are spot-welded to one another, so that a flexible interlayer with good contact is created.

[0008] A drawback which has emerged in the prior art is that an oxide layer, which in the area without material-to-material bonding consists of Cr_2O_3 (Cr_xO_y), and in the area with material-to-material bonding probably consists of an CrNi spinel, grows in the region of direct contact between the nickel mesh and CrFe5 both during soldering of the fuel cell stack and during operation of the fuel cell or of the fuel cell stack. These oxide layers are thought to be largely responsible for the excessively high series resistances of the high-temperature fuel cells. Consequently, the electrical output is greatly adversely affected.

[0009] Moreover, during soldering of the fuel cell stack using a glass solder in an air atmosphere, the nickel mesh is oxidized at the surface of the wires, to a depth of a few μm into the interior of the wires. The formation of nickel(II) oxide (NiO), which has a volume which is approximately 16% greater than nickel, leads to an increase in thickness of the overall mesh assembly of around 10-40 μm (depending on the soldering conditions). The increase in thickness in the oxidized region of the wire is more than 16%, since the NiO formed is porous. During the oxidation, the nickel meshes and their wires sinter together. During the subsequent reduction of the nickel mesh, the original thickness of the mesh assembly is restored or even, under certain circumstances, reduced further.

[0010] During this reduction, the nickel wires sinter together, so that a reduction in the desired flexibility and also a reduction in the thickness occur, which is undesirable. The reduction in thickness may also lead to contact separation, which can lead to damage to components.

SUMMARY OF THE INVENTION

[0011] The invention is based on an object of further developing a fuel cell or a fuel cell stack in such a manner that the reduction in thickness and flexibility of the nickel mesh(es) is avoided. As such, contact between the anode and the interconnector plate which is as complete as possible can be achieved.

[0012] This object is achieved by patent claim 1. Advantageous refinements of the fuel cell will emerge from subclaims 2-8.

[0013] In one embodiment, at least one metallic mesh, which is protected against oxidation, is inserted between anode and interconnector plate in order to flexibly make contact.

[0014] Meshes of this type as the contact layer have the advantage that they can no longer be oxidized, and consequently the increase in thickness is also eliminated. Since no oxidation has taken place, there is also no need for a reduction of the metallic meshes. Further, the associated drawbacks, such as for example contact separations during the reduction in thickness or flexibility losses, do not occur. On account of the fact that the oxidation/reduction process does not take place, the original thickness and flexibility of the oxidation-protected meshes is retained, so that a contact layer which makes very good contact between anode and interconnector is created. Moreover, a reduction in the thickness of the metallic meshes as the service life progresses is prevented.

[0015] The metallic meshes are expediently coated with an oxidation-resistant protective layer. In this way, the metallic meshes, e.g. nickel meshes, remain unaffected both in terms of their composition and in terms of their mechanical and electrical properties, i.e., inter alia, they remain substantially flexible, do not bring about any change in thickness and substantially retain their advantageous properties. It is advantageous in this case that, before being introduced as flexible contact layer, the metallic meshes are subjected to the coating process. The assembly with the other components and the soldering are then to be carried out in the customary way.

[0016] Coated nickel meshes can be provided as metallic meshes. The nickel meshes satisfy the requirements with regard to flexibility and also electrical conductivity.

[0017] The metallic meshes provided may also be coated stainless steel meshes, which have the property of only being superficially oxidized, down to a depth of approximately 5 μm. The stainless steel meshes are in this case likewise coated with an oxidation-resistant protective layer. A further advantage of the stainless steel meshes is that their coefficient of thermal expansion is well matched to the thermal characteristics of the components of the fuel cell stack. This property is highly advantageous in particular when the fuel cell operates at high temperatures.

[0018] The protective layer advantageously contains chromium, and is therefore matched to the chemical composition of the interconnector plate.

[0019] The protective layer advantageously includes chromium carbide, which is highly electrically conductive and adheres very well to the metallic mesh. Moreover, a chromium carbide layer is very resistant to corrosion at corresponding oxygen partial pressures on the fuel gas side. Furthermore, these layers are stable when methane or gases derived from carbon, which are later charge media on the fuel gas side of the high-temperature fuel cell, are used.

[0020] A further advantage of the coating with chromium carbide consists in the fact that, when using gases which are derived from carbon and are passed through the gas ducts on the anode side of the interconnector plates, minor constituents of the protective layers are restored again by the gases derived from carbon. Therefore, the chromium carbide layer is particularly favorable in thermodynamic terms.

[0021] By way of example, the chromium carbide used may be Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$.

[0022] It is also possible for the protective layer of the metallic meshes to include chromium nitride.

[0023] The protective layer expediently has a thickness d of 0.1-10 μm, so that, firstly, sufficient resistance to oxidation is provided and, secondly, the flexibility of the metallic meshes is scarcely restricted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The invention is explained in more detail with reference to an advantageous exemplary embodiment shown in the drawings, in which:

Fig. 1 shows a diagrammatic cross-sectional illustration of the layers of a fuel cell, and

Fig. 2 shows an enlarged, diagrammatic cross-sectional illustration of a coated nickel mesh.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] A fuel cell 1, in one embodiment corresponding to the diagrammatic illustration in Fig. 1, includes an interconnector plate 5', a protective layer 8, a contact layer 9, a cathode 2, an electrolyte 3, an anode 4, two metallic meshes 6, 6' which rest on top of one another, and an interconnector plate 5. Such a fuel cell 1 as shown in Fig. 1 can be part of a fuel cell stack. The components are preferably arranged in parallel, in layers, on top of one another. The metallic meshes can be nickel, and the metallic mesh 6 is preferably thinner than the mesh 6'.

[0026] The nickel meshes 6, 6' are protected against oxidation, in order to avoid oxidation of these meshes, which usually occurs during soldering of the entire fuel cell stack. The oxidation of the nickel meshes is linked to an increase in thickness, the original thickness of the mesh assembly being restored during the subsequent reduction operation. This may lead to contact separations, which can cause damage to components. Moreover, after the reduction the nickel wires become sintered together, so that the desired flexibility is reduced. Accordingly, the oxidation-protected meshes avoid the oxidation/reduction process of the mesh assembly and the associated drawbacks. The original flexibility and the thickness of the meshes can be retained, so that complete contact between anode 4 and the contact layer of the

nickel meshes 6, 6' and the interconnector plate 5 is created. Moreover, a reduction in thickness of the nickel meshes 6, 6' during operation of the fuel cell 1 is prevented.

[0027] As can be seen from Fig. 1 and Fig. 2, the nickel meshes 6, 6' are provided with an oxidation-resistant protective layer 7. This coating may be carried out before assembly of the individual components. Therefore, the original, advantageous properties of the nickel meshes 6, 6' are not changed by an oxidation process and a subsequent reduction process. Fig. 2 shows an enlarged excerpt illustrating the coating of a nickel mesh 6 or 6'.

[0028] Stainless steel meshes, which have the advantage of a coefficient of longitudinal thermal expansion being matched to the components of the high-temperature fuel cell, may also be provided instead of the nickel meshes 6, 6'.

[0029] The protective layer 7 includes chromium carbide, which has the advantage that, when using gases derived from carbon, which are introduced through the gas ducts on the anode side of the interconnector plates 5, 5', constituents which disappear from the protective layers are restored again by the gases derived from carbon.

[0030] Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$ or similar chromium carbides with different valencies can be used as chromium carbides.

[0031] The protective layer 7 has a thickness d of 0.1-10 μm, in order to reliably prevent oxidation and to scarcely affect the flexibility of the nickel meshes 6, 6'.

[0032] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

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MARKED-UP SPEC

~~Description~~

PCT (2071 filed 8/26/00)

Electrical Bonding ~~Oxidation-~~Protected Against Oxidation ~~electrical contact-making element~~ on the ~~fuel~~ Combustion Gas Side of a High-Temperature Fuel Cell

FIELD OF THE INVENTION

The invention generally relates to a fuel cell or a fuel cell stack. ~~having the further features of the preamble of patent claim 1~~.

BACKGROUND OF THE INVENTION

It is known that connecting a plurality of fuel cells in series results in a fuel cell stack. Such a fuel cell stack ~~which~~, in order, includes ~~comprises~~ an interconnector plate, a protective layer, a contact layer, a cathode, an electrolyte, an anode, a further contact layer and a further interconnector plate. The interconnector plate forms a unit with the protective and contact layers, which are each sprayed on. Cathode, electrolyte and anode form the electrolyte/electrodes unit. The corresponding units are laid in parallel, in layers, on top of one another and the same sequence is repeated a number of times.

Cathode, electrolyte and anode form an electrolyte/electrodes unit. In each case one electrolyte/electrodes unit, lying between adjacent interconnector plates, together with the contact and protective layers which bear directly against the electrolyte/electrodes unit on both sides, forms a high-temperature fuel cell. The fuel cell ~~which~~ also includes those sides of each of the two interconnector plates which bear against the protective layer or the contact layers. The interconnector plates usually consist of CrFe5 with 1% of Y oxide, known as an ODS alloy.

Gas ducts, through which, firstly, the fuel gas, for example hydrogen or methane (natural gas), and, secondly, oxygen or air is passed, are formed in the interconnector plate. The hydrogen is passed to the anode side, the oxygen or air to the cathode side.

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These gases are passed through at a relatively low excess pressure of less than 1 bar.

The planar design of the high-temperature fuel cell requires the contact between the electrodes in both gas spaces to be over as much of the surface as possible. On the cathode side, contact with the electrode is ensured by a contact layer made from La perovskite, e.g. $La_8SrO_{0.2}MnO_3$. This perovskite is stable in air. By contrast, on the fuel cell side contact with the electrode, i.e. the anode, is more difficult to achieve. However, complete contact with the anode is necessary, on account of the low transverse conductivity of the anode. The anode is produced by the screen-printing process and is therefore not planar over the entire surface, which means that a flexible contact-making element which has very good electrical conductivity and must be able to withstand an operating period of approximately 40,000 h is required.

The prior art provides for nickel meshes to be used as flexible contact-making elements. By way of example, a fine nickel mesh and a coarse nickel mesh are laid on top of one another and are spot-welded to one another, so that a flexible interlayer with good contact is created.

A drawback which has emerged in the prior art is that an oxide layer, which in the area without material-to-material bonding consists of Cr_2O_3 (Cr_xO_y), and in the area with material-to-material bonding probably consists of an CrNi spinel, grows in the region of direct contact between the nickel mesh and CrFe5 both during soldering of the fuel cell stack and during operation of the fuel cell or of the fuel cell stack. These oxide layers are thought to be largely responsible for the excessively high series resistances of the high-temperature fuel cells. Consequently, the electrical output is greatly adversely affected.

Moreover, during soldering of the fuel cell stack using a glass solder in an air atmosphere, the nickel mesh is oxidized at the surface of the wires, to a depth of a few μm into the interior of the wires. The formation of nickel(II) oxide (NiO), which has a volume which is approximately 16% greater than nickel, leads to an increase in thickness of the overall mesh assembly of around 10-40 μm (depending on the soldering conditions). The increase in thickness in the oxidized region of the wire is more than 16%, since the NiO formed is porous. During the oxidation, the nickel meshes and their wires sinter together. During the subsequent reduction of the nickel mesh, the original thickness of the mesh assembly is restored or even, under certain circumstances, reduced further.

During this reduction, the nickel wires sinter together, so that a reduction in the desired flexibility and also a reduction in the thickness occur, which is undesirable. The reduction in thickness may also lead to contact separation, which can lead to damage to components.

SUMMARY OF THE INVENTION

The invention is based on ~~the~~ an object of further developing a fuel cell or a fuel cell stack, ~~having the features of the preamble of patent claim 1~~ in such a manner that the reduction in thickness and flexibility of the nickel mesh(es) is avoided. ~~so that~~ As such, contact between the anode and the interconnector plate which is as complete as possible can be achieved.

This object is achieved by ~~the characterizing features of~~ patent claim 1. Advantageous refinements of the fuel cell will emerge from subclaims 2-8.

~~The essence of the invention is regarded as being that~~ In one embodiment, at least one metallic mesh, which is protected against

oxidation, is inserted between anode and interconnector plate in order to flexibly make contact.

Meshes of this type as the contact layer have the advantage that they can no longer be oxidized, and consequently the increase in thickness is also eliminated. Since no oxidation has taken place, there is also no need for a reduction of the metallic meshes. Further, ~~with~~ the associated drawbacks, such as for example contact separations during the reduction in thickness or flexibility losses, do not occur. On account of the fact that the oxidation/reduction process does not take place, the original thickness and flexibility of the oxidation-protected meshes is retained, so that a contact layer which makes very good contact between anode and interconnector is created. Moreover, a reduction in the thickness of the metallic meshes as the service life progresses is prevented.

The metallic meshes are expediently coated with an oxidation-resistant protective layer. In this way, the metallic meshes, e.g. nickel meshes, remain unaffected both in terms of their composition and in terms of their mechanical and electrical properties, i.e., inter alia, they remain substantially flexible, do not bring about any change in thickness and substantially retain their advantageous properties. It is advantageous in this case that, before being introduced as flexible contact layer, the metallic meshes are subjected to the coating process. The assembly with the other components and the soldering are then to be carried out in the customary way.

Coated nickel meshes can be provided as metallic meshes. The nickel meshes satisfy the requirements with regard to flexibility and also electrical conductivity.

The metallic meshes provided may also be coated stainless steel meshes, which have the property of only

being superficially oxidized, down to a depth of approximately 5 μm. The stainless steel meshes are in this case likewise coated with an oxidation-resistant protective layer. A further advantage of the stainless steel meshes is that their coefficient of thermal expansion is well matched to the thermal characteristics of the components of the fuel cell stack. This property is highly advantageous in particular when the fuel cell operates at high temperatures.

The protective layer advantageously contains chromium, and is therefore matched to the chemical composition of the interconnector plate.

The protective layer advantageously includes ~~consists of~~ chromium carbide, which is highly electrically conductive and adheres very well to the metallic mesh. Moreover, a chromium carbide layer is very resistant to corrosion at corresponding oxygen partial pressures on the fuel gas side. Furthermore, these layers are stable when methane or gases derived from carbon, which are later charge media on the fuel gas side of the high-temperature fuel cell, are used.

A further advantage of the coating with chromium carbide consists in the fact that, when using gases which are derived from carbon and are passed through the gas ducts on the anode side of the interconnector plates, minor constituents of the protective layers are restored again by the gases derived from carbon. Therefore, the chromium carbide layer is particularly favorable in thermodynamic terms.

By way of example, the chromium carbide used may be Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$.

It is also possible for the protective layer of the metallic meshes to include ~~consist of~~ chromium nitride.

The protective layer expediently has a thickness d of 0.1-10 μm, so that, firstly, sufficient resistance to oxidation is provided and, secondly, the flexibility of the metallic meshes is scarcely restricted.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained in more detail with reference to an advantageous exemplary embodiment shown in the drawings, in which:

Fig. 1 shows a diagrammatic cross-sectional illustration of the layers of a fuel cell, and

Fig. 2 shows an enlarged, diagrammatic cross-sectional illustration of a coated nickel mesh.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

~~The fuel cell stack of the~~ A fuel cell 1, in one embodiment corresponding to the diagrammatic illustration in Fig. 1, ~~comprises~~ includes an interconnector plate 5′, a protective layer 8, a contact layer 9, a cathode 2, an electrolyte 3, an anode 4, two ~~nickel~~ metallic meshes 6, 6′ which rest on top of one another, and an interconnector plate 5. Such a fuel cell 1 as shown in Fig. 1 can be part of a fuel cell stack. The ~~these~~ components ~~being~~ are preferably arranged in parallel, in layers, on top of one another. The metallic meshes can be nickel, and the metallic ~~nickel~~ mesh 6 ~~is~~ is preferably thinner than the ~~nickel~~ mesh 6′.

The nickel meshes 6, 6′ are protected against oxidation, in order to avoid oxidation of these meshes, which usually occurs during soldering of the entire fuel cell stack. The oxidation of the nickel meshes is linked to an increase in thickness, the original thickness of the mesh assembly being restored during the subsequent reduction operation. This may lead to contact separations, which can cause damage to components. Moreover, after the reduction the nickel wires become sintered together, so that the desired flexibility is reduced. Accordingly, the oxidation-protected meshes avoid the oxidation/reduction process of the mesh assembly and the associated drawbacks. The

original flexibility and the thickness of the meshes can be retained, so that complete contact between anode 4 and the contact layer of the nickel meshes 6, 6′ and the interconnector plate 5 is created. Moreover, a reduction in thickness of the nickel meshes 6, 6′ during operation of the fuel cell 1 is prevented.

As can be seen from Fig. 1 and Fig. 2, the nickel meshes 6, 6′ are provided with an oxidation-resistant protective layer 7. This coating may be carried out before assembly of the individual components. Therefore, the original, advantageous properties of the nickel meshes 6, 6′ are not changed by an oxidation process and a subsequent reduction process. Fig. 2 shows an enlarged excerpt illustrating the coating of a nickel mesh 6 or 6′.

Stainless steel meshes, which have the advantage of a coefficient of longitudinal thermal expansion being matched to the components of the high-temperature fuel cell, may also be provided instead of the nickel meshes 6, 6′.

The protective layer 7 ~~consists of~~ includes chromium carbide, which has the advantage that, when using gases derived from carbon, which are introduced through the gas ducts on the anode side of the interconnector plates 5, 5′, constituents which disappear from the protective layers are restored again by the gases derived from carbon.

Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$ or similar chromium carbides with different valencies can be used as chromium carbides.

The protective layer 7 has a thickness d of 0.1-10 μm, in order to reliably prevent oxidation and to scarcely affect the flexibility of the nickel meshes 6, 6′.

VARIATIONS

MARKED-UP CLAIMS

What is claimed is:

~~Patent cla~~ims

1. (Amended) A fuel cell [(1) or a fuel cell stack], [having] comprising: [cathodes (2) arranged in parallel in layers,] a cathode; an electrolyte [(3),]; an anode; [anodes (4) and] an interconnector plates [(5, 5'), as well as] at least one metallic mesh [(6, 6') which is], inserted between the anode [(4)] and an interconnector plate [(5)] for flexibly making contact, [characterized in that] wherein the at least one metallic mesh [(6, 6')] is protected against oxidation.

2. (Amended) The fuel cell as claimed in claim 1, [characterized in that] wherein the at least one metallic mesh [(6, 6')] is coated with an oxidation-resistant protective layer [(7)].

3. (Amended) The fuel cell as claimed in [one of claims] claim 1 [or 2], [characterized in that] wherein the mesh [(6, 6')] is a coated nickel mesh.

4. (Amended) The fuel cell as claimed in claim 1 [one of the preceding claims], [characterized in that] wherein the mesh [(6, 6')] is a coated stainless steel mesh.

5. (Amended) The fuel cell as claimed in claim 2 [claims 2-4], [characterized in that] wherein the protective layer [(7)] [contains] includes chromium.

6. (Amended) The fuel cell as claimed in claim 2 [one of the preceding claims 2-5], [characterized in that] wherein the protective layer [(7) consists of] includes ~~chromi~~um carbide.

7. (Amended) The fuel cell as claimed in claim 6, [characterized in that] wherein at least one of Cr_3C_2, CrC, Cr_7C_3 [or] and $Cr_{23}C_6$ is used as chromium carbide.

8. (Amended) The fuel cell as claimed in claim 1 [one of the preceding claims], [characterized in that] wherein the protective layer

[(7)] has a thickness [(d)] of approximately 0.1-10 μm.

NEW

9. same as 3, but dep on 2
10. same as 4, but dep on 2
11. same as 5, but dep on 3
12. " 5 " 4
13. " 6 " 3
14. " 6 " 4
15. " 6 " 5

16. A fuel cell stack, comprising: a plurality of fuel cells, each fuel cell including,
[same body as claim 1]

17. The fuel cell stack of claim 16,
[same body as cl. 2]

18. The fuel cell stack of claim 16,
[same body as cl. 3]

19. same as 18, but dep on 17

20. The fuel cell stack of claim 16,
[same body as Cl. 4]

Abstract

~~Oxidation-protected electrical contact-making element on the fuel gas side of a high-temperature fuel cell~~

~~The invention relates to a~~ A fuel cell ~~(1)~~ or a fuel cell stack, ~~having~~ includes cathodes ~~(2)~~ arranged in parallel in layers, an electrolyte ~~(3)~~, anodes ~~(4)~~ and interconnector plates ~~(5, 5')~~. ~~as well as~~ Further, at least one metallic mesh ~~(6, 6')~~ is included, which is inserted between an anode ~~(4)~~ and an interconnector plate ~~(5)~~ for flexibly making contact. ~~wherein~~ The at least one metallic mesh ~~(6, 6')~~ is protected against oxidation.

~~Fig. 1~~

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Description

Oxidation-protected electrical contact-making element on the fuel gas side of a high-temperature fuel cell

The invention relates to a fuel cell or a fuel cell stack having the further features of the preamble of patent claim 1.

It is known that connecting a plurality of fuel cells in series results in a fuel cell stack which, in order, comprises an interconnector plate, a protective layer, a contact layer, a cathode, an electrolyte, an anode, a further contact layer and a further interconnector plate. The interconnector plate forms a unit with the protective and contact layers, which are each sprayed on. Cathode, electrolyte and anode form the electrolyte/electrodes unit. The corresponding units are laid in parallel, in layers, on top of one another and the same sequence is repeated a number of times.

Cathode, electrolyte and anode form an electrolyte/electrodes unit. In each case one electrolyte/electrodes unit, lying between adjacent interconnector plates, together with the contact and protective layers which bear directly against the electrolyte/electrodes unit on both sides, forms a high-temperature fuel cell, which also includes those sides of each of the two interconnector plates which bear against the protective layer or the contact layers. The interconnector plates usually consist of CrFe5 with 1% of Y oxide, known as an ODS alloy.

Gas ducts, through which, firstly, the fuel gas, for example hydrogen or methane (natural gas), and, secondly, oxygen or air is passed, are formed in the interconnector plate. The hydrogen is passed to the anode side, the oxygen or air to the cathode side.

These gases are passed through at a relatively low excess pressure of less than 1 bar.

The planar design of the high-temperature fuel cell requires the contact between the electrodes in both gas spaces to be over as much of the surface as possible. On the cathode side, contact with the electrode is ensured by a contact layer made from La perovskite, e.g. $La_8SrO_{0.2}MnO_3$. This perovskite is stable in air. By contrast, on the fuel cell side contact with the electrode, i.e. the anode, is more difficult to achieve. However, complete contact with the anode is necessary, on account of the low transverse conductivity of the anode. The anode is produced by the screen-printing process and is therefore not planar over the entire surface, which means that a flexible contact-making element which has very good electrical conductivity and must be able to withstand an operating period of approximately 40,000 h is required.

The prior art provides for nickel meshes to be used as flexible contact-making elements. By way of example, a fine nickel mesh and a coarse nickel mesh are laid on top of one another and are spot-welded to one another, so that a flexible interlayer with good contact is created.

A drawback which has emerged in the prior art is that an oxide layer, which in the area without material-to-material bonding consists of Cr_2O_3 (Cr_xO_y), and in the area with material-to-material bonding probably consists of an CrNi spinel, grows in the region of direct contact between the nickel mesh and CrFe5 both during soldering of the fuel cell stack and during operation of the fuel cell or of the fuel cell stack. These oxide layers are thought to be largely responsible for the excessively high series resistances of the high-temperature fuel cells. Consequently, the electrical output is greatly adversely affected.

Moreover, during soldering of the fuel cell stack using a glass solder in an air atmosphere, the nickel mesh is oxidized at the surface of the wires, to a depth of a few μm into the interior of the wires. The formation of nickel(II) oxide (NiO), which has a volume which is approximately 16% greater than nickel, leads to an increase in thickness of the overall mesh assembly of around 10-40 μm (depending on the soldering conditions). The increase in thickness in the oxidized region of the wire is more than 16%, since the NiO formed is porous. During the oxidation, the nickel meshes and their wires sinter together. During the subsequent reduction of the nickel mesh, the original thickness of the mesh assembly is restored or even, under certain circumstances, reduced further.

During this reduction, the nickel wires sinter together, so that a reduction in the desired flexibility and also a reduction in the thickness occur, which is undesirable. The reduction in thickness may also lead to contact separation, which can lead to damage to components.

The invention is based on the object of further developing a fuel cell or a fuel cell stack having the features of the preamble of patent claim 1 in such a manner that the reduction in thickness and flexibility of the nickel mesh(es) is avoided, so that contact between the anode and the interconnector plate which is as complete as possible can be achieved.

This object is achieved by the characterizing features of patent claim 1. Advantageous refinements of the fuel cell will emerge from subclaims 2-8.

The essence of the invention is regarded as being that at least one metallic mesh, which is protected against

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oxidation, is inserted between anode and interconnector plate in order to flexibly make contact.

Meshes of this type as the contact layer have the advantage that they can no longer be oxidized, and consequently the increase in thickness is also eliminated. Since no oxidation has taken place, there is also no need for a reduction of the metallic meshes, with the associated drawbacks, such as for example contact separations during the reduction in thickness or flexibility losses, do not occur. On account of the fact that the oxidation/reduction process does not take place, the original thickness and flexibility of the oxidation-protected meshes is retained, so that a contact layer which makes very good contact between anode and interconnector is created. Moreover, a reduction in the thickness of the metallic meshes as the service life progresses is prevented.

The metallic meshes are expediently coated with an oxidation-resistant protective layer. In this way, the metallic meshes, e.g. nickel meshes, remain unaffected both in terms of their composition and in terms of their mechanical and electrical properties, i.e., inter alia, they remain substantially flexible, do not bring about any change in thickness and substantially retain their advantageous properties. It is advantageous in this case that, before being introduced as flexible contact layer, the metallic meshes are subjected to the coating process. The assembly with the other components and the soldering are then to be carried out in the customary way.

Coated nickel meshes can be provided as metallic meshes. The nickel meshes satisfy the requirements with regard to flexibility and also electrical conductivity.

The metallic meshes provided may also be coated stainless steel meshes, which have the property of only

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being superficially oxidized, down to a depth of approximately 5 μm. The stainless steel meshes are in this case likewise coated with an oxidation-resistant protective layer. A further advantage of the stainless steel meshes is that their coefficient of thermal expansion is well matched to the thermal characteristics of the components of the fuel cell stack. This property is highly advantageous in particular when the fuel cell operates at high temperatures.

The protective layer advantageously contains chromium, and is therefore matched to the chemical composition of the interconnector plate.

The protective layer advantageously consists of chromium carbide, which is highly electrically conductive and adheres very well to the metallic mesh. Moreover, a chromium carbide layer is very resistant to corrosion at corresponding oxygen partial pressures on the fuel gas side. Furthermore, these layers are stable when methane or gases derived from carbon, which are later charge media on the fuel gas side of the high-temperature fuel cell, are used.

A further advantage of the coating with chromium carbide consists in the fact that, when using gases which are derived from carbon and are passed through the gas ducts on the anode side of the interconnector plates, minor constituents of the protective layers are restored again by the gases derived from carbon. Therefore, the chromium carbide layer is particularly favorable in thermodynamic terms.

By way of example, the chromium carbide used may be Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$.

It is also possible for the protective layer of the metallic meshes to consist of chromium nitride.

The protective layer expediently has a thickness d of 0.1-10 μm, so that, firstly, sufficient resistance to oxidation is provided and, secondly, the flexibility of the metallic meshes is scarcely restricted.

The invention is explained in more detail with reference to an advantageous exemplary embodiment shown in the drawings, in which:

Fig. 1 shows a diagrammatic cross-sectional illustration of the layers of a fuel cell, and

Fig. 2 shows an enlarged, diagrammatic cross-sectional illustration of a coated nickel mesh.

The fuel cell stack of the fuel cell 1 corresponding to the diagrammatic illustration in Fig. 1 comprises an interconnector plate 5′, a protective layer 8, a contact layer 9, a cathode 2, an electrolyte 3, an anode 4, two nickel meshes 6, 6′ which rest on top of one another, and an interconnector plate 5, these components being arranged in parallel, in layers, on top of one another. The nickel mesh 6 is thinner than the nickel mesh 6′.

The nickel meshes 6, 6′ are protected against oxidation, in order to avoid oxidation of these meshes, which usually occurs during soldering of the entire fuel cell stack. The oxidation of the nickel meshes is linked to an increase in thickness, the original thickness of the mesh assembly being restored during the subsequent reduction operation. This may lead to contact separations, which can cause damage to components. Moreover, after the reduction the nickel wires become sintered together, so that the desired flexibility is reduced. Accordingly, the oxidation-protected meshes avoid the oxidation/reduction process of the mesh assembly and the associated drawbacks. The

original flexibility and the thickness of the meshes can be retained, so that complete contact between anode 4 and the contact layer of the nickel meshes 6, 6′ and the interconnector plate 5 is created. Moreover, a reduction in thickness of the nickel meshes 6, 6′ during operation of the fuel cell 1 is prevented.

As can be seen from Fig. 1 and Fig. 2, the nickel meshes 6, 6′ are provided with an oxidation-resistant protective layer 7. This coating may be carried out before assembly of the individual components. Therefore, the original, advantageous properties of the nickel meshes 6, 6′ are not changed by an oxidation process and a subsequent reduction process. Fig. 2 shows an enlarged excerpt illustrating the coating of a nickel mesh 6 or 6′.

Stainless steel meshes, which have the advantage of a coefficient of longitudinal thermal expansion being matched to the components of the high-temperature fuel cell, may also be provided instead of the nickel meshes 6, 6′.

The protective layer 7 consists of chromium carbide, which has the advantage that, when using gases derived from carbon, which are introduced through the gas ducts on the anode side of the interconnector plates 5, 5′, constituents which disappear from the protective layers are restored again by the gases derived from carbon.

Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$ or similar chromium carbides with different valencies can be used as chromium carbides.

The protective layer 7 has a thickness d of 0.1-10 μm, in order to reliably prevent oxidation and to scarcely affect the flexibility of the nickel meshes 6, 6′.

Patent claims

1. A fuel cell (1) or a fuel cell stack, having cathodes (2) arranged in parallel in layers, electrolyte (3), anodes (4) and interconnector plates (5, 5'), as well as at least one metallic mesh (6, 6') which is inserted between anode (4) and interconnector plate (5) for flexibly making contact, characterized in that the at least one metallic mesh (6, 6') is protected against oxidation.

2. The fuel cell as claimed in claim 1, characterized in that the at least one metallic mesh (6, 6') is coated with an oxidation-resistant protective layer (7).

3. The fuel cell as claimed in one of claims 1 or 2, characterized in that the mesh (6, 6') is a coated nickel mesh.

4. The fuel cell as claimed in one of the preceding claims, characterized in that the mesh (6, 6') is a coated stainless steel mesh.

5. The fuel cell as claimed in claims 2-4, characterized in that the protective layer (7) contains chromium.

6. The fuel cell as claimed in one of the preceding claims 2-5, characterized in that the protective layer (7) consists of chromium carbide.

7. The fuel cell as claimed in claim 6, characterized in that Cr_3C_2, CrC, Cr_7C_3 or $Cr_{23}C_6$ is used as chromium carbide.

8. The fuel cell as claimed in one of the preceding claims, characterized in that the protective layer

(7) has a thickness (d) of approximately 0.1-10 μm.

Abstract

Oxidation-protected electrical contact-making element on the fuel gas side of a high-temperature fuel cell

The invention relates to a fuel cell (1) or a fuel cell stack, having cathodes (2) arranged in parallel in layers, electrolyte (3), anodes (4) and interconnector plates (5, 5'), as well as at least one metallic mesh (6, 6') which is inserted between anode (4) and interconnector plate (5) for flexibly making contact, wherein the at least one metallic mesh (6, 6') is protected against oxidation.

Fig. 1

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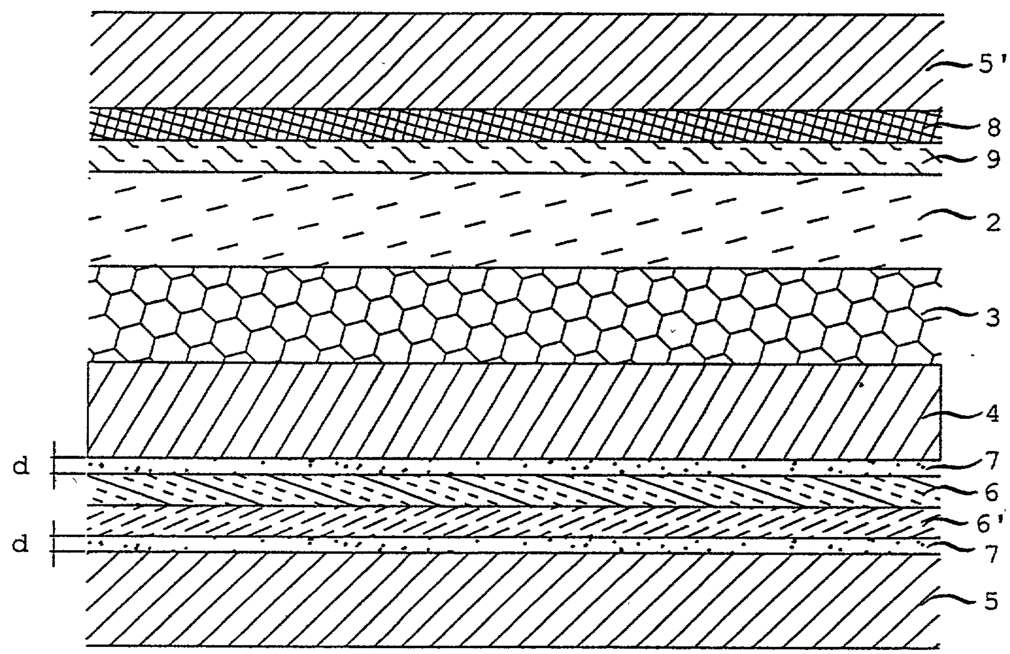

FIG. 1

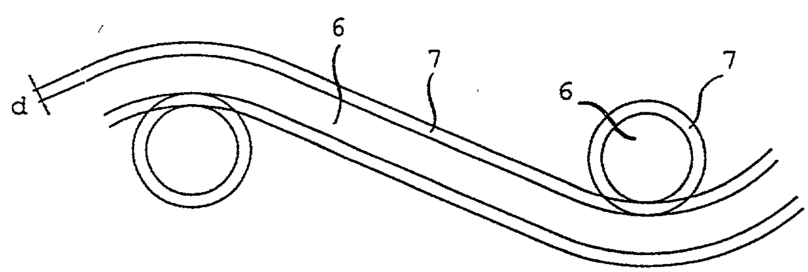

FIG. 2

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Oxidationsgeschützte elektrische Kontaktierung auf der Brenngasseite der Hochtemperatur-Brennstoffzelle

ELECTRICAL BONDING PROTECTED AGAINST OXIDATION ON THE GAS COMBUSTION SIDE OF A HIGH TEMPERARTURE FUEL CELL

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 26. Juni 2000als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/02071
eingereicht wurde und am ________
abgeändert wurde (falls tatsächlich abgeändert).

the specification of which

(check one)
☐ is attached hereto.
☒ was filed on 26. Juni 2000 as
PCT international application
PCT Application No. PCT/DE00/02071
and was amended on ________
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

IDNR: 2590 / V: 99-1.00 / B:Val

German Language Declaration

Prior foreign appplications
Priorität beansprucht

Priority Claimed

19932192.2	DE	09.07.1999	☒	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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01-50

Voller Name des einzigen oder ursprünglichen Erfinders:	Full name of sole or first inventor:
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Unterschrift des Erfinders / Datum: X [signature] X27.12.2001	Inventor's signature / Date
Wohnsitz: Nürnberg, DE X	Residence: Nürnberg,
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: Kilianstrasse 46	Post Office Addess: Kilianstrasse 46
90425 Nürnberg	90425 Nürnberg
Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor, if any:
Unterschrift des Erfinders / Datum	Second Inventor's signature / Date
Wohnsitz: ,	Residence: ,
Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

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